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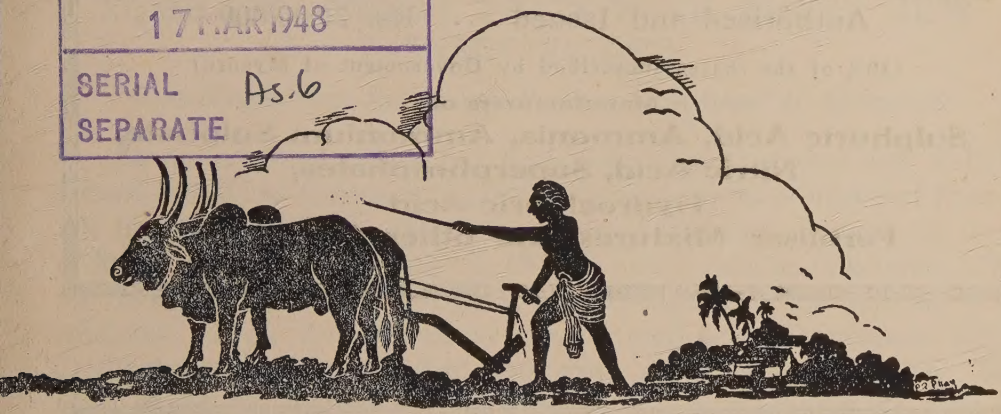

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Some Biological Tests with Three New Insecticides
Agricultural Sayings

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Vol. XXIV] 1945—46 [No. 3

SOME BIOLOGICAL TESTS WITH THREE NEW INSECTICIDES

Contribution from Entomology Section, Department of Agriculture

Laboratory (and only a few field) tests were conducted with D.D.T. Hexa 3—(666) and Gammexane D 919 on several species of insects of Economic importance. D.D.T. (Dicholoro diphenyl Tricholoroethane) in the form of fine powder in mixture with talc (50 : 50) and in solution in kerosene (5%) was used both as dust and spray as a water suspension as well as soap emulsion. Hexa 3 (666-Benzene-Hexachloride) and Gammexane (10%) D 919 were also used as fine dust and spray solutions of emulsions. The effect of the two latter substances were found to be practically the same in the case of most of the insects used for testing. (It could not be otherwise considering the fact that Gammexane contains the only toxic isomer, *i.e.*, Gamma 1.2.3.4.5.6—of the three isomers alpha, beta and gamma of Hexa 3, the alpha and beta isomers being non-toxic.) For practical purposes in general insect control work, Hexa 3 and Gammexane might be considered to be one and the same.

These insecticides were tested both as stomach and contact poison on representative types of Lepidoptera (moths), Coleoptera (beetles), Hymenoptera (ants), Rhynchota (bugs) and Orthoptera (cockroach). Their effect on plant pests under actual field conditions is bound to be influenced by variations in temperature and relative humidity and other physical factors, and before extensive field tests are conducted locally they cannot be recommended for general use.

The following table embodies details of the tests conducted.

Insecticide	Form in which used	Insect used		Dose %	Exposure	Mortality %	Remarks
		group	Name				
D.D.T. ..	Dust	Lepidoptera	*Argyria stictic aspis* 1st instar	1	24 hours	100	Sugar-cane shoot borer
,, ..	,,	,,	*Pericallis recimi.* IV inst.	5	3 days	90	
,, ..	,,	,,	*Utetheisa pulchella* III inst.	5	8 hours	100	Sunnhemp caterpillar
Hexa 3 ..	,,	,,	,,	5	24 ,,	100	
Gammexane D. 919	,,	,,	,,	2	24 ,,	100	
D.D.T. ..	,,	,,	*Crocidolomia, binotalis* II inst.	2	12 ,,	100	Cabbage caterpillar
Hexa 3 ..	,,	,,	,,	2	12 ,,	100	,,
Gammexane D. 919	,,	,,	,,	2	12 ,,	100	,,
D.D.T. ..	,,	Hymenoptera	*Athalia proxima* II inst.	5	24 ,,	100	
Hexa 3 ..	,,	,,	,,	5	8 ,,	100	
Gammexane D. 919	,,	,,	,,	5	8 ,,	100	
D.D.T. ..	Dust Spray (water suspension)	,,	*Camponotus Monomorium*	1, 2 & 5	15 days	Nil	Common species of ants
Hexa 3 ..	Dust	,,	*Solenopsis*	5	24 hours	100	Effect lasted for 7 days carrier woodash
D.D.T. ..	,,	Coleoptera	*Phyllotreta* sp.	1	24–48 hrs.		
,, ..	,,	,,	*Epilachna* III inst.	2	48 hours		Potato beetle
,, ..	,,	,,	,,	5	,, ,,	100	
Hexa 3 ..	,,	,,	,,	5	72 ,,	100	
Gammexane D. 919	,,	,,	,,	5	72 ,,	80	
,, ..	,,	,,	,,	5	48 ,,	80	
D.D.T. ..	Dust & spray	,,	*Xylotrechus quadripes* (adults)	5	34 ,,	100	Coffee Borer beetle. No effect on eggs and grubs (billets treated and beetles introduced)
,, ..	,,	,,	,,	1	48 ,,	100	Beetles died after laying eggs
Hexa 3 ..	Dust	,,	,,	5	24 ,,	100	,,
Gammexane D 919 ..	,,	,,	,,	5	48 ,,	100	,,
D.D.T. ..	,,	Rhynchota	*Coptosoma cribraria* (adults)	1	24–48 hrs.	100	Do. Cabbage bug
,, ..	,,						
		,,	*Bagrada picta* (adults)	1	Do.	100	

Insecticide	Form in which used	Insect used		Dose %	Exposure	Mortality %	Remarks
		Group	Name				
D.D.T. ..	Dust	Rhynchota	*Idiocerus* sp. Nymphs	2·5	48 hours	100	Mango hoppers; effect lasted 5–7 days
,, ..	Spray	,,	,,	2	24 ,,	100	Effect 15 days
Hexa 3 ..	Dust	,,	,,	10	24 ,,	100	7 days
,, ..	Spray	,,	,,	3	24 ,,	100	10 ,,
Gammexane D 919	Dust	,,	,,	10	48 ,,	100	7 ,,
,, ..	Spray	,,	,,	3	24 ,,	100	10 ,,
D.D.T. ..	Dust, Spray (water suspension)	,,	(Adults)	1, 2 & 5	15 days	Nil	
,, ..	,,	,,	*Orthesia insignis*	,,	15 ,,	Nil	Lantana Mealy-Bug
,, ..	Spray	,,	Cimex	0·3 g. + 12 g. of lime 75 c.c. of water	24 hours	90%	Bed bug. Bugs introduced into crevices in wall and furniture and sprayed
Hexa 3 ..	,,	,,	,,	,,	3–5 hrs.	100	,,
Gammexane D. 919	,,	,,	,,	,,	Do.	100	,,
,, ..	Dust	,,	,,	,, 5%	5 hours	100	Bugs allowed to crawl on powder in dishes
Hexa 3 ..	,,	,,	,,	,, 5%	5 ,,	100	,,
D.D.T. ..	Bait	Orthoptera	*Peripla nata* (Cockroach)	2	2–5 days	100	Cockroach. Blotting paper soaked in 2% water suspension
,, ..	Dust	,,	,,	50	24 hours	100	Inner surface of jars dusted and cockroaches put in.
Hexa 3 ..	Bait	,,	,,	½ g. of 5% powder in ½ oz. tamarind		100	2–3 weeks. Repulsive smell
,, ..	Dust	,,	,,	50	24 hours	100	Effect lasted for 4 days
Gammexane D. 919	Bait	,,	,,	½ g. of 5% powder in ½ oz. of tamarind	8 days	100	
,, ..	Dust	,,	,,	50	24 hours	100	,,
D.D.T. ..	,,	Arachnida	Ticks on dogs	5	18 ,,	100	
Hexa 3 ..	,,	,,	,,	5	18 ,,	100	
Gammexane D. 919	,,	,,	,,	5	18 ,,	100	

THE USE OF 'CYANOGAS' DUST AS A FUMIGANT FOR FOODGRAINS

By D. Seshagiri Rao, B.Sc.

Owing to the difficulty of getting adequate supplies of known fumigants like carbon-disulphide for grain fumigation work at that time, the possibility of utilising Calcium cyanide, available in a proprietary form called 'Cyanogas'—for this purpose was investigated in the Entomological Laboratory in August 1944 and subsequent months. Hydrocyanic acid gas fumigation of godowns and warehouses by the 'Pot method' using Sodium or Potassium cyanide and dilute Sulphuric acid for generating the gas is a well-known method, but the process is very elaborate and should be attempted with extreme care as there is great risk of cyanide poisoning to the workers. 'Cyanogas' also releases Hydrocyanic acid gas on exposure to the moisture in the atmosphere, but as it can be easily pumped into an air-tight chamber from outside with a foot pump duster, specially devised for the purpose this risk is almost entirely eliminated.

'Cyanogas' has been long in use in public health work for rat-control and disinfestation of houses, household effects and grains from fleas, etc., when there is an outbreak of plague. Its use in Agricultural Entomology is generally restricted to the control of soil insects especially ants, termites and other root infesting forms. 'Cyanogas' is produced in different granulations, each suitable for certain types of fumigations, and of these, the fine dust or powder, styled the 'A' dust is most useful for grain fumigation work being the only form of 'Cyanogas' which can be applied with a pump.

In preliminary trials, in the laboratory and godown, the fumigant was introduced in a thin layer on the floor, the dose employed varying from 1 lb. to 3 lbs. per 1,000 cubic feet. In glass jars having ground glass covers and the laboratory steel fumigation box, the lower dose resulted in total mortality of all species,—*Calandra, Tribolium, Rhizopertha* beetles and *Corcyra* and *Sitotroga* moths. Under godown conditions with the grain spread on the floor and also in the bags this dose proved to be inadequate, and this method of spreading the fumigant thinly on sheets of paper proved unsatisfactory. There was greater rate of mortality in the upper tier of bags than in the bottom ones, showing that the gas being lighter than air had more effectively penetrated into the top bags. Regarding the dose for bulk scale fumigation, it should be obviously higher than in small glass or metal air-tight receptacles since there is always the likelihood of leakage from even a terraced room however carefully it is made air-tight for fumigation work. Therefore, from actual trials it was found that a dose of 2 lbs. to 3 lbs. for 1,000 c. ft. of space would be necessary in bulk-work. From actual experience it was found to be risky to apply the fumigant at this rate on the floor in a thin layer, and besides it was found difficult to spread it in sufficiently thin layers in the

necessarily restricted alley-ways between the stacks. This method was, therefore, subsequently abandoned in favour of pumping in the chemical with the ' Cyanogas ' foot pump duster.

The following table shows the results of some godown trials with ' Cyanogas ' fumigation :—

Date of fumigation	Nature and quantity of grains	Dose of fumigant	How introduced	Interval for fumigation	Rate of mortality
16—8—1944	15 bags jola 10 bags gram	1 lb. per 1000 Cft.	Spread on paper	1 day	Weevils 93% Bruchids Total Tribolisum Mostly alive
1—9—1944	40 bags wheat	,,	,,	,,	Large number of weevils alive and active on floor. Inside bags 94% mortality
10—9—1944	12 bags wheat 36 bags Tur dhall	,,	,,	,,	Large number of weevils alive on floor and wall. Mortality 80% in top tier bags and 76% in bottom tier
22—11—1944	31 bags Tur dhall (covered with tarpaulin)	1½ lbs. per 1000 Cft.	Pumped	,,	Not successful
23—11—1944	25 bags Tur dhall (covered with tarpaulin)	,,	,,	,,	,,
28—11—1944	20 bags wheat (covered with tarpaulin)	,,	,,	,,	40% mortality of weevils
29—11—1944	Do.	,,	,,	,,	Average mortality 81·7 % Bottom tier 75·5 % Top tier 94·4 %
25—12—1944	50 bags gram	2 lbs. per 1000 Cft.	,,	2 days	Very successful. Actual counts not taken
31—1—1944	90 bags Tur dhall	3 lbs. per 1000 Cft.	,,	,,	83% mortality due to fumigation (deducting percentage of natural mortality)
4—5—1946	31 bags wheat	,,	,,	3 days	99·7% average mortality. Samples of heavily infested grain kept at different levels, including in glass jar on window sill.

' Cyanogas ' fumigation does not appear to affect viability of the seeds. Germination tests with fumigated jola and Black gram seeds gave 36% and 88% of germination respectively.

Hydrocyanic acid gas is not considered to have very good penetrative property and similarly ' Cyanogas ' fumigation will not be very effective or satisfactory if the fumigation room is filled to its capacity with grain bags. It is necessary to ensure that there is sufficient air-space between bag and bag, for the gas pumped from outside, to reach each individual bag. This may be ensured by stacking the bags ' loosely ', *i.e.*, in such a manner that there is a little space (some 6" width) left between each bag in the row and between two rows in the tier, and that the bags of the next tier are placed in an

'alternate' position to those of the lower one and so on. If the bags can be stacked in an interlocking manner with inter-space as suggested above, it is better than all the bags pointing the same way. A gap or an alley-way between the wall and the stack is desirable as it enables a more effective circulation of the gas. This 'loose' stacking of bags will reduce the total capacity of the room to about half its normal capacity. Thus in a room measuring 1,000 c. ft. not more than 100 bags may be stacked and possibly even less as it is difficult to pile them up to the very ceiling. Of course, as the gas is lighter than air, it is advantageous to stack as high as possible.

A terraced or ceilinged room having fairly well-fitting doors and window shutters can be easily made air-tight by closing any chinks and crevices in the wood work with mud plaster with or without paper strips over it. It is desirable that a round hole 1" or 1½" in diameter is bored at the bottom of the door so that the hose of the pump may be slipped in through it, and the door kept completely closed before the pumping operation begins so that there is no danger of the dust issuing out of the door way as the pumping reaches a certain stage. If it is not possible to thrust in the hose through such a hole, then it can be led in through the doorway (one shutter being closed, if there are two) at the bottom, the door (or the open shutter) being kept open only to the extent of admitting the hose inside. Folded gunny bags may be thrust into the opening while the pumping is in progress to prevent the dust from coming out and affecting the operator. Towards the end when the room is full of dust some of it escapes outside, which the worker may avoid by turning his back to the door.

Depending on the size of the room, and the distance of the door from the farther wall it is necessary to fix a length of free rubber hose to the short length of hose attached to the pump. The hose may extend with advantage to a little beyond the middle of the room, its free end resting preferably, on the floor, in some clear space between the bags. The pump may be just outside the door, or preferably some distance away to avoid inhaling the dust, if any, coming out from the chink in the door. If the room is big and has more than one door, then more than one pump may be employed. It is advisable to have two men per pump and one extra hand for filling the dust containers, as they get exhausted. One man should not be allowed to pump in more than one pound of dust at a time, and should go out into the fresh air as soon as his turn at the pump is over. As the glass container received with the pump holds approximately one pound when full, it is not necessary to actually weigh the dust.

In very dry weather it is preferable to hang a few strips of gunny cloth soaked in water in the room for quick evolution of Hydrocyanic acid gas. The dose as indicated above may vary from 2 lbs. to 3 lbs. per 1,000 c. ft., depending on the method of stacking, nature of infestation, etc. An interval of 2 to 3 days may be allowed for the fumigation, after which the door may be opened wide, and no one allowed to enter inside (or even go near the

open door) for an hour or two, till all traces of the Hydrocyanic acid gas, if any, disappears. The room may then be entered into safely, but not for any protracted stay inside, as the lurking smell of Hydrocyanic acid gas is unpleasant, if not dangerous. Within three days more if the doors are kept closed, or 6 to 8 hours if they are kept fully open, the room is perfectly safe for any one to enter and stay in for collecting samples, removing the bags, etc. No elaborate tests as with a rat in a cage at the end of a pole or analysis of the air inside to see if any residual Hydrocyanic acid is present have been undertaken so far, nor has there been any mishap or danger to the staff till now.

The bagged grain shows a faint smell of the fumigant which disappears entirely in about 6 to 8 hours if the grain is aerated or in 2 to 3 days if kept without disturbance in the same room. No stocks of wheat flour, maida, soji or other milled products have been atttempted to be fumigated so far with cyanogas. Rice has been rarely treated, with however, no discolouration of the grains. A total number of 18,500 bags of foodgrains, consisting of wheat, jola, bengal gram, black gram and Tur dhall have been successfully fumigated so far in various godowns of the Food Supply Department in Bangalore City, Mysore City, Bowringpet and Kolar Gold Fields. The insects infesting these grains were *Calandra* (weevil), *Rhizopertha* and *Tribolium* beetles, *Bruchids* (pulse beetles) and *Corcyra* or Rice moths. In addition a fairly large number of rats (and in one instance a number of sparrows) are invariably found dead, mostly in the alley-ways leading to the doors, as though frantically but unsuccessfully trying to escape. A few however, get caught under the bags and this requires shifting the bags about to some extent when the dead rats start smelling. Apart from foodgrains, about 80,000 empty, used gunny bags have been cyanogassed till now.

Regarding the cost of this method of fumigation, the approximate cost of one pound of chemical may be taken as Rs. 1-8-0 in bulk packing. Assuming that 3 lbs. are needed for 1,000 c.ft. or a minimum of 75 bags of grain, the cost of fumigation works up to less than one anna per bag, exclusive of labour and supervision charges. This is at present, therefore, the cheapest fumigant available for this purpose.

In conclusion, the proprietary 'Cyanogas' 'A' dust is an effective and cheap fumigant for bagged, whole foodgrains. The bags have to be stacked 'loosely' in an air-tight, terraced room. The suggested dose is 2 to 3 lbs. per 1,000 c.ft. holding about 75 to 100 bags, the chemical being pumped from outside through a foot pump duster. 2 to 3 days after fumigation, the room may be opened, and entered into after allowing time for the gas, if any, to escape. It costs about one anna to fumigate a bag of grain.

I am greatly indebted to the Director of Food Supplies in Mysore for permission to conduct the trials in the godowns of the Food Supply Department, to Mr. M. J. Narasimhan, Director of Agriculture in Mysore and Mr. B. Krishnamurti, Entomologist to the Government of Mysore for guidance and helpful suggestions and criticisms during these investigations.

THE BIOLOGY AND CONTROL OF THE SHOT-HOLE BORER *XYLEBORUS MORSTATTI* HAGD. OF *COFFEEA ROBUSTA*

By M. Appanna, B.Sc.

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Introduction

Popularly called the Shot hole borer—on account of its habit of making in the twigs of *Coffeea robusta* a circular hole resembling that made by a bullet or shot—this insect is a Scolytid beetle. Though it is reported to attack other varieties of coffee, in Mysore it does considerable damage to *Coffeea robusta* exclusively. Consequent on the increase in the extent of *Coffeea robusta* in Mysore in recent years the incidence of the pest is also gradually increasing.

Systematic Position

This insect belongs to the family Scolytidæ under the sub-order *Rhynchophora* and order *Coleoptera*. It is placed under the genus *Xyleborus* which includes a large number of shot hole borers. Speyer, in his 'Notes upon the habits of Ceylonese Ambrosia beetles', has referred to the insect attacking *Coffeea robusta* twigs in Ceylon as *Xyleborus compactus* Eich. Beeson in his book on the 'Biology of the Genus *Xyleborus* with more new species' infers that the insect referred to as *Xyleborus compactus*, Eich. by Speyer may be the same as the one found on *Coffeea robusta* in South India—*Xyleborus morstatti*, Hagd.

Brief Description of Adult and Earlier Stages

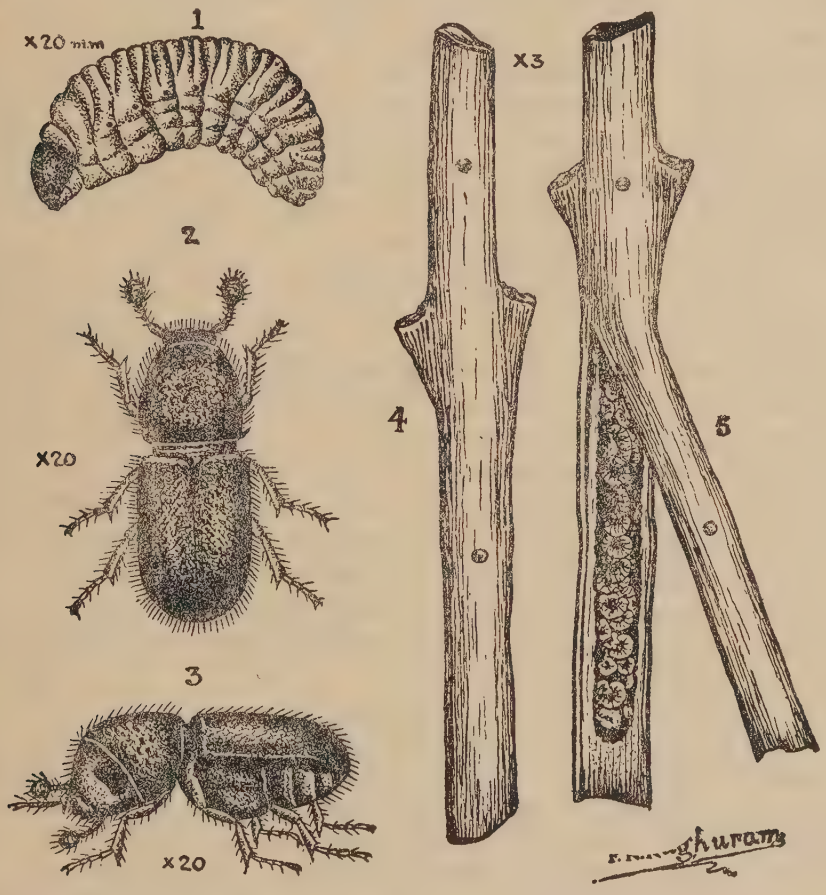
The adult is a typical testaceous brown coloured Scolytid beetle possessing a short and almost cylindrical body eminently adapted for its boring habit. It is a minute individual measuring about 1·8 to 2·6 mm. Slight variations in size are met with, the female being invariably larger.

The eggs which are white in colour, slightly globular and flattened at one end are laid in the gallery in small clusters. Larvæ that hatch out are white, fusiform and legless possessing dentate mandibles and a small and highly chitinised head. The pupa is naked and white in colour.

Host Plants

Beeson records this insect on four important plants—*Hopea parviflora*, *Coffeea robusta* (South India), *Swietenia macrophylla*, and *S. Mahagoni* (Java and Ceylon). Other authors have recorded it in *Coffeea arabica*, *C. canephora*, *C. stenophylla*, *Melia* sp., *Erythrina* sp. and *Persea gratissim a.* Recent observations in Mysore have shown that this insect is also found on *Crotolaria anagyroides*, *Clerodendron* sp. and *Pavetta* sp. The insects bred on *Crotolaria* have been successfully reared on *Coffeea robusta* and *vice versa.*

Unlike the stem borer of *Coffeea arabica, Xylotrechus quadripes,* Chevr., which bores into the stem, the shot hole borer of *Coffeea robusta—Xyleboru morstatti,* Hagd., attacks the twigs of young and old plants. The damage caused by this pest is only partial and as such has not received the same attention as the other pest. In addition *Coffeea robusta* being a heavier yielder of the two, the loss sustained due to the drying up of few attacked twigs on a plant is not considered to be heavy. But it must be remembered that any insect that gains possession of the crop gradually turns out to be a pest if not checked before it has increased unduly.



The Shot-hole Borer of *Coffeea robusta, Xyleborus morstatti,* Hagd.

1. Fully developed grub.
2. Adult (Front view).
3. Adult (Side view).
4. *Coffeea robusta* twig showing the ' shot-holes '.
5. *Coffeea robusta* twig split open to show the gallery with the grubs.

Habits

Of the two sexes, the female beetle is more active and capable of short flights, while the male generally does not quit the host plant. When disturbed

the female becomes active whereas the male shams death and begins to move after some time. Copulation seems to take place early after emergence of adults (about 14–16 hours). After copulation the female beetle moves about and selects a place for boring into the twig. After making a circular hole in the twig, the female parent excavates a small tunnel at right angles and lines its inner walls with the fungus—Ambrosia—which is of vital importance for the development of the young ones.

The mother beetle attacks usually on the lower side of the twigs, though attacks on the lateral sides of the twigs are not infrequent. The preference of the beetle to select the lower sides of the twigs seems to be to avoid direct sun's rays which may be deterimental to the normal development of the Ambrosia fungus. In addition the attack is seen to be always more frequent in succulent shoots and under heavy shade where there is a greater conservation of moisture. It may be of interest to note that the mother beetle after laying the eggs is always seen to remain at the entrance to the gallery usually adpressing its posterior dorsal surface to the hole. This may be to keep off enemies like the ants, spiders, etc.

Nature of Damage

The insects by tunnelling into the tender twigs cause the drying up of the branches from the tip. The damage could be easily made out by the dark brown colour of the attacked twigs, and by the drooping and drying leaves. If the attack is yet in the initial stages, it can be made out by the brown markings (patches) just near and around the place of attack.

The gallery made by this insect is of a simple type. It consists of a short tunnel along the long axis of the twig with occasional side projections. The gallery is wider at the entrance hole than in other places. In heavily infested twigs, these galleries made by different parent beetles unite with one another and display a complicated pattern of simple branching at almost right angles in all directions.

Life History

It may be mentioned at the outset that individual rearing of the insect from the egg to the adult stage could not be adopted due to various practical difficulties. On the other hand rearing of individuals of a single brood collectively was adopted and the following table gives some of the data.

The life cycle of the insect extends over a period of 14 to 17 days in cut twigs kept moist and observations made once a day as stated above. Likewise the beetle completes its life cycle in young seedlings in pots in the same number of days. It may perhaps be stated here that in nature the length of life cycle may be curtailed by another 2 or 3 days as there will be no frequent disturbance and as the parent insect would have chosen an ideal place for breeding.

The mother beetle, after preparing the gallery and lining it with the Ambrosia fungus, commences to lay eggs in clusters of 5 to 8 held together

Eggs laid on	No. of days	Larvæ hatched on	No. of days	Larvæ pupated on	No. of days	Adults emerged on
10-11-1940	2	12-11-1940 (18)	11	23-11-1949 (3)	4	27-11-1940 (12)
(26)	3	13-11-1940 (8)	12	24-11-1940 (8)	3	28-11-1940 (9)
			13	25-11-1940 (9)	3	29-11-1940 (4)
			13	26-11-1940 (4)	2	
			14	27-11-1940 (1)		
8-11-1940	2	10-11-1940 (10)	12	22-11-1940 (9)	3	25-11-1940 (8)
(17)	3	11-11-1940 (7)	14	24-11-1940 (7)	2	26-11-1940 (8)
			13			
18-10-1941	2	20-10-1941 (19)	10	30-10-1941 (1)	3	3-11-1941 (10)
(30)	3	21-10-1941 (11)	11	31-10-1941 (8)	3	4-11-1941 (11)
			13	1-11-1941 (6)	2	5-11-1941 (5)
			12	3-11-1941 (7)		
				3-11-1941 (6)		
2—2-1942	2	4—2-1942 (10)	12	16—2-1942 (6)	4	20—2-1942 (9)
(19)	3	5—2-1942 (9)	13	17—2-1942 (3)	3	21—2-1942 (5)
			15	18—2-1942 (2)	2	22—2-1942 (4)
				20—2-1942 (7)		
9—2-1942	2	11—2-1942 (13)	12	22—2-1942 (8)	3	26—2-1942 (9)
(15)	3	12—2-1942 (2)	13	24—2-1942 (4)	4	27—2-1942 (2)
			14	25—2-1942 (1)	2	28—2-1942 (2)

N. B.—The numbers in brackets represent the number of eggs, larvæ and pupæ that have undergone a change on that date. It may be noted that the number of eggs and the number of adults do not tally. This difference is due to the death of the insect in various stages of development.

by means of the mucilagenous substance in the gallery. Each parent beetle lays on an average 26 eggs, the minimum and maximum number recorded being 10 and 31 respectively. Larvæ hatch out 2–3 days after the eggs are laid. The larva possesses the characteristic features of a typical larva of the Xyleborus genus. The larval period extends over a period of 11–13 days. The full grown larva measures 2·4 mm. to 2·9 mm. The pupa is found in the gallery and there is no special pupal cell or chamber in which the larva pupates. The pupal period extends over a period of 3 days usually though early and later emergences are met with.

Slight variations in the life cycle of individual larvæ in one and the same gallery are not uncommon. These may be due to causes like, earlier hatching, competition for food, etc. Any way, it is a common sight to see larvæ and pupæ together in the same gallery.

Ecological Factors Affecting the Incidence of the Pest

As already stated a high percentage of humidity favours the rapid multiplication of the insect. There is no definite period during which the insect is said to be at its peak emergence. This is because, the insect, in all its stages of development, is found during any part of the year. But there are definite indications to show that the insect is at its maximum activity during the monsoon season—July-September. The following table gives the details month-war regarding the incidence, population, etc., of the pest.

From the table it can be seen that the incidence of the insect is light and heavy during summer and monsoon seasons respectively. The high relative humidity during the rainy season favours the development

Month	Percentage of galleries in which the insect is found	Ratio	
		Adults	Larvæ
January ..	48	3	2
February ..	33	5	2
March ..	24	6	1
April ..	33	8	3
May ..	42	4	3
June ..	57	1	1
July ..	87	1	..
August ..	79	1	16
September ..	62	8	3
October ..	78	8	3
November ..	51	7	2
December ..	48	4	3

N.B.—Pupæ are counted as larvæ for purposes of calculating the ratio in the last column.

of the Ambrosia fungus vital for the development of the larvæ. Thus we find that a high percentage of galleries are thickly populated. The contrary of this reasoning holds good for the summer season when the incidence is at its lowest. A heavy shade also preserves the high humidity which promotes the growth of the fungus thus creating an incentive for the parent beetle to propagate its species rapidly.

Control

From a study of the habits of the insect and the various factors that favour the development of the insect, it seems to be practicable and profitable to adopt the following mechanical methods of controlling the pest.

Pruning.—The affected twigs should be pruned at least 1″ to 1½″ away from the emergence hole towards the centre of the plant. This wards off the usual mistake of breaking the twigs at the point of attack and thus allowing a certain percentage of larvæ to develop in the twig. It seems to be advantageous to put this operation into practice twice in a year, during the heavy and low incidence periods of the pest.

Regulation of Shade.—Heavy shade being directly favourable to the rapid breeding of the pest, should be avoided and a uniform thin shade is to be maintained in areas where *Coffeea robusta* is planted.

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References

Beeson, C. F. C. .. 'The Biology of the genus Xyleborus with more new species,' *The Indian Forest Records* (Entomology series) **14**, Part 10.

——— .. *Forest Insects.*

Speyer, E. R. .. 'Notes upon the habits of Ceylonese Ambrosia beetles,' *Bulletin of Entomological Research*, 1923, **14**, 11–34.

Agricultural Sayings or the Farmer's Wisdom

By M. Vasudeva Murthy, B.Ag., and R. S. Aiyangar, B.Ag.

The wisdom of our farmers is contained in the many agricultural sayings in vogue. The sayings touch upon various aspects of farming, but the greater number of them are such as might pass under the heading, weather wisdom. This is as might be expected in a country predominantly dependent on rain; where is rain not important for the farmer? Not only those pithy sayings that may properly be termed proverbs, are of interest in this regard but many an other statement based on observation of nature fits into the category, statements indebted to a variety of sources ranging from books of poetry to newspaper columns.

Our farmers count their seasons in terms of months, feasts and rain-stars.

(1) The rains of Deepavali have the wealth of an ocean in them (*Deevalige male sagaradantha male*).—the ending wovels are pronounced.

(2) The rains of the Holi-feast fill the threshing yards with water (*Kamana habbakke kanagalalli niru*).

We find feasts mentioned in these statements. Deepavali comes in October and the Holi feast generally in March.

Months according to the local Calendar are mentioned in sayings like the following:

(1) No rains after the month of Kartik, no battle after the death of Karna (reference to Mahabharata) (*Kartikavada mele male illa, Karna teerikonda mele yuddhavilla*).

(2) If rains appear in the month of Phalguna the crops are surely gone (*Phalgunada male nasa madthu bele*).

The months of the local Calender are twelve. They overlap English months slightly differently each year but the general parallel may be indicated with dates of one particular year.

Local months	From English month and date	To English month and date
Chaitra	April 3	May 1
Vaisakha	May 1	May 30
Jyesta	May 31	June 29
Ashadha	June 30	July 28
Sravana	July 29	August 26
Bhadrapada	August 27	September 25
Aswija	September 26	October 24
Kartika	October 25	November 23
Margasira	November 24	December 23
Pushya	December 24	January 22
Magha	January 23	February 21
Phalguna	February 22	March 23

Thirteen months appear during an year at intervals and the calender is set right; that is by the way.

A large number of sayings are in terms of rain-stars as follows:—

(1) The rains at Uttara, Revathi and Bharani promise plenty; rains at Aswini forebode scarcity (*Uttara purva sasyani, apara sasyani revati, sarvam nasyanthi aswini, bharani sarva sasyani*).

(2) Aridra, Makha, Pubba and Uttara are rains suitable for all sowings. (*Harastharastondu gada, Thandaranandanadondu gada, nanda kandanadondu gada, gowri-nandanadondu gada*).

(3) It is not propitious if Ashwini rains, if Aridra thunders and if Ashadha showers (*Aswini bilalu, aridre garjisalu, ashadhadalli male baralu lesalla sarvagna*).

(4) Ashwini destroys plants (*Aswini sasya nashini*).

(5) Sun is scorching in Bharani; one cannot withstand it (*Bharani bisalu bharisoke agodilla*).

(6) When the Bharani rains the land yields its fruits (*Bharani kuruste dharani pandunu*—Telugu).

(7) *Til* (sesamum) sown in Krittika rain yields a bumper crop (*Krittike maleyalli bittidare kurithashtu yellu*).

(8) If Rohini rains all foot-paths grow Jowar (*Rohini male bandare oni ella jola*).

(9) Finish your sowing of *til* (sesamum) by the rains of Mrigasira (*Mikka yellu mishkirili chellu*).

(10) At the down-pour of Mrigasira even a bull began to bleet (*Mrigasira hoyyalu mudi yettu garjisitu*).

(11) In Mrigasira the rain simply pours down, in Makha it is simply noisy (*Mrigasira hoyyoke, makha gudugoke*).

(12) The Mrigasira rain determines the Mungar crops (*Mrigasira male, mungaru bele*).

(13) By the rains of Aridra, finish your sowings, let no ploughed land remain unsown (*Aridra malege agiruva ukkege biththi bidu*).

(14) Aridra is the most timely rain (*Aridra sakalada male*).

(15) When Aridra thunders forth its way—six rains simply stop away (*Aridre gudugidare aru male baruvudilla*).

(16) Aslesha rain washes of all dirt (*Aslesha male nissesha kole*).

(17) When Aslesha rains, it brings a bumper crop (*Ashlesha male kaitumba bele*).

(18) If sun shines in Aslesha the rain simply evaporates away (*Aslesha aviyagi hogutte*).

(19) With Aslesha to their aid plants rise to mountain heights (*Aslesha malege sasi guddaveruththe*).

(20) If it pours Magha pours well, if it goes it goes like vapour (*Bandare maghe, hodare hoge*).

(21) Pubba is a mad rain; it may not wet a sparrow's feather. (*Hubba hutchu male—gubbi pukka neneyodilla*).

(22) If Uttara fails, brings back your basket (no grain to harvest) (*Uttara pothe ettara gampa*—Telugu).

(23) If Uttara thunders it means there will be no rain (*Uttara gudugidare male illa*).

(24) How can the world prosper when the Uttara rain fails, and one's own mother leaves one to be a destitute? (*Uttare husidu, heththamma muniyalu, loka yeththa badukuvadu sarvagna* ?).

(25) If the rains of Hasta fail, even the mother will refuse to feed her child (*Hasthe male biladiddare heththa thayi hittu ikkodilla*).

(26) When Hasta begins on a Sunday it tires all people down (*Aditya-vara banda hastha madtelra susta*).

(27) The Hasta rain feeds the people (*Haste hittu ikkuththe*).

(28) Hasta makes horsegram yield six grains, Chitta makes it yield three (*Hastakke aru kalu, Chittakke muru kalu*).

(29) Hasta rains as it pleases (*Attada male yeththeththago* ?).

(30) Hasta is timely—Chitta yields (Bili jola—Jowar—sown in Chitta yields a good crop) (*Hastakke hada, Chittakke bele*).

(31) Why think of Chitta when Hasta blows all wind? (*Halaytu Chitta gali tandu hasta*).

(32) Chitta rains in a blind down pour (*Kurudu Chiththe*).

(33) Chitta rain brings hoppers and insects with it (*Chiththe male baruvaga chittegalu bandavanthe*).

(34) As the father so the son; as the rain of Chitta, so the rain of Swati (*Tandeyante maga; chiththeyanthe swathi*).

(35) Swati, the pearl rain (*Swati soudamini tatha*—Sanskrit).

(36) As a genuine pearl born of the Swati shower (*Swati male biddu jati muththu adante*).

(37) Visakha sees the end of all rain bearing clouds (*Visakanthani meghani*).

(38) If Visakha begins to rain it pours with the persistence of a devil (*Visakha hididare pisachi hididanthe*).

(39) When Anuradha rains it makes one lively (*Anuradha suridare manoroga hoguththe*).

There are 27 stars. Their coincidence with months of the English calender, along with the agricultural operations may be indicated side by side in a table.

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t in the names of rains and Kannada words in most cases above is to be pronounced as *th*; and *d* as *dh*.

Calender month	Rain stars	Preparatory cultivation	Sowings	Harvests	Other operations
April ..	Revathi (last rain) March 30 to April 12. Aswini—April 13 to April 25	Time to cart silt to dry lands. Green manure seeds may be sown in paddy lands	..	Harvest of early summer paddy and ragi	Time to spray coffee estates
May ..	Bharani—April 26 to May 9. Krithika—May 10 to May 23	Green manure seeds may be sown in paddy plots	Mungar crops, til, jola, greengram and groundnut are sown	..	Time to spray against Koleroga of areca
June ..	Rohini—May 24 to June 6. Mrigasira—June 7 to June 20	Ploughing all lands and making ready for sowing	Time to sow jola, doddahatti, cotton, dry land paddy	..	..
July ..	Aridra—June 21 to July 4. Punarvasu—July 5 to July 18	..	Ragi, jola, ground nut, bajra, same, haraka and mixture crops are sown in dry lands. Nurseries are sown for paddy, chillies, tobacco, etc.	..	Spraying potatoes
August ..	Pushya—July 19 to August 1. Aslesha—August 2 to August 15. Makha—August 16 to August 29	Sannahatti is sown with mixture of Navane where in vogue. Seedlings which are ready are transplanted	..	..	Spraying potatoes, grapes, etc., interculture standing crops
September	Pubba—August 30 to Sept. 12. Uttara—Sept. 13 to 25	..	Black cotton soils, tank-beds and bunded fields may be sown with crops like wheat and Bengalgram	Crops sown in Bharani are harvested now	Spraying continued where necessary
October ..	Hasta—Sept. 26 to October 9. Chitta—October 10 to 22	..	Sowing of Hingar crops, jola, bengal gram, blackgram, coriander and Wheat. Potatoes are planted	..	..
November	Swati—October 23 to Nov. 4. Visakha—Nov. 5 to 18. Anuradha—Nov. 19 to Dec. 1	..	..	Picking Doddhatti cotton, selection of ragi earheads	Time for ensiling fodders grown for the purpose
December	Jyeshta—Dec. 2 to 14. Mula—December 15 to 27	Ploughing the lands after harvest if possible	..	Harvest of all Hain crops	Spraying of standing potato crop
January	Purvashadha—Dec. 28 to Jan. 9 Uttarashadha—Jan. 10 to 22	..	Sowing bilijola and nursaries of Vaisakha paddy and Nataragi. Planting sugar-cane	..	Honge oil soap treatment for mango hoppers
February	Sravana—Jan. 23 to Feb. 4 Dhanishta—Feb. 18 to March 2	..	Transplanting of Vaisakha paddy and Nataragi Planting sugar-cane.	..	Milling of cane; threshing of grain
March	Purvabhadra—March 3 to 16. Uttarabhadra—March 17 to 29	..	Planting of sugarcane. Sowing several vegetables in garden lands	Picking Sannahatti cotton	Milling of cane

The duration of each rain star is divided into 4 divisions called feet. Thus if a star runs for 12 days, each foot of it has 3 days. It will be observed that the effective rain-star season commencing with the rain of Revathi and ending with Anuradha coincides with the season commencing from April and closing with November. And counting by star periods affords a fine measure of the details of the season. The rainless portion of the year is devoted to cultivations dependent on irrigation and threshing operations.

So for about the sayings in which the names of the rain-stars appear. Then there are a number of general sayings about rainfall which may be grouped with other statements that speak of the weather.

(1) (Said of a woman) There is no famine when rains fall, and there is no fear when one is with a husband (*Male bile baravilla, gandanire bhayavilla*).

(2) No harm if it rains (*Male age kedilla*).

(3) Even a beating rain is welcome (*Hutchu male adaru lesu*).

(4) Arecanut is no food; and an untimely rain is no rain (*Adike aharavalla, kalakke agada male male alla*).

(5) An untimely rain is like a dried up stream (*Akalada male, nirillada hole*).

(6) An early rain is like a mother's call (*Munde ada male matheyanthe*).

(7) Dark is the cloud near a forest (*Kadina samipa kala megha*).

(8) Rain that commenced on a Saturday cleared the next Saturday (*Shanivara banda male mundina Shanivara ninthithu*).

(9) The morning's rain and the morning's visitor do not stay long (*Belagge banda male, belagge banda nenta hetchu hottu irodilla*).

(10) The early mornings rain and the evening's guest do not go away easily (*Belagina java banda male, baigu banda nenta bittuhoguvudilla*).

(11) Who can ever know when the life goes out of the body or rain falls from the sky? (*Prana hoguvudannu, male baruvudannu yaru ballaru*).

Well, here are some weather clinics, with acknowledgements to original sources.

(12) If cocks crow late or early, clapping their wings excessively, rain may be expected.

(13) When peacocks are noisy it is a sign of rough weather.

(14) When wood-peckers are very demonstrative it is a sign of rain.

(15) If owls hoot freely it is a sign of fair weather.

(16) If crows congregate in large numbers it is a sign of rain.

(17) If sparrows chirrup a good deal rain will follow.

(18) When frogs croak much, when toads come out of their holes and walk about with legs extended it is a sign that rain is impending.

(19) If bees stay at home rain will soon come; if they fly away fine will be the day.

(20) When spiders crawl on the walls rain is certainly expected, but if they work during rain, the rain will not last long.

(21) If persons who are rheumatic complain more than usual and if corns and wounds, new or old, itch or ache more than usual it is a certain proof that rain is imperative.

(22) Sometimes walls look more damp before the advent of rain.

(23) The fall of soot down a chimney is generally the forerunner of the approach of rain.

(24) Many salts begin to run when the weather is moist.

(25) If on the trees the leaves or still, the coming winter will be cold.

(26) Hallows which as spectacles are extremely rare, are nearly sure to be followed by rain and unsettled weather.

(27) A very bright aurora is a forerunner of an approach of storm. It is accompanied by excessive cold.

(28) A damp and mild March is a bad omen for summer and autumn crops, for with such a weather in March the rains of June and July fail.

(29) A cold and dry March with a cold and wet April augurs better for the summer and autumn crop.

(30) A wet May, a big load of hay.

(31) A leaky May and a warm June bring on the harvest very soon.

(32) A cold and wet June spoils the rest of the year.

(33) A wet June makes a dry September.

(34) When distant sounds such as bells and railway whistles are unusually distinct or shrill, rain may soon be expected, when the source of the sound is not situated to the east of the listener.

(35) Doors and windows are hard to shut in damp weather.

The rain and the weather factor on which he stakes so much help the farmer but he must needs think of his soil, seeds, manures and economics before he reaps the fruit of his holding. There are sayings pertaining to these aspects which further contribute to the farmer's wisdom.

Sayings pertaining to Soil

(1) Know the crop by the stubble (*Belege sakshi kule*).

(2) Farm the red soil and be in debt (perhaps a black cotton soil farmer's view) (*Kebbe nela mai tumba sala*).

(3) The sandy soil is a hungry soil (*Maralu bhumige, kshuthitha mrithige*).

(4) Believe in the black cotton soil, believe in the king (*Ere nambido dore nambido*).

(5) Salt in the soil, growth in the eye (*Choulu bhumi mannu, anabe bele kannu*).

(6) A crop in an alkaline soil is like moisture in a water-less stream (*Choulu nelada bele, nirillada hole*).

Sayings that pertain to Ploughing and Manuring

(1) Soup without spice, soil without tillage (*Voggarane illada saru, uttillada bhumi*).

(2) Plough deep; not wide (*Alakkulu, agalakke beda*).

(3) Armed with manure—even a fool's farm is secure (*Heddana aramba gobbaradalli*).

(4) Plough the land seven times (*Yelu sari ulu*).

(5) Moisture enough to plough is like mother's love (*Ukke pasume thaya olume*).

(6) One digging, ten times ploughing (*Ondu agetha, haththu ulume*).

(7) As a Brahmin wants ghee, so the land requires manure (*Brahmanarige thuppa, bhumige gobbara*).

(8) Weeds dead, a bumper crop ahead (*Saththu hoda kale, kai tumba bele*).

(9) Weed the land, take the full crop in hand (*Kiththu haku kale, kaithumba bele*).

(10) Use the cattle manure in the dry land; use the green manure in wet land (*Danada gobbara holakke; yele gobbara gaddege*).

(11) It is enough if sheep tread on the field (refers to sheep folding for fertilising the land).

(12) A basket of ragi to the shepherd, the dropping of his sheep to the ragi land (*Kurubanige thoride ragi kukke, atha thorida kuri hikke*).

(13) As the flour, so the cake; as the feed, so the cattle; as the manure, so the grain (*Hittinanthe dose, meluvinanthe dana, gobbaradanthe dhanya*).

Sayings pertaining to Crops and Cropping

(1) Plant your plantains deep and your cocoanuts shallow (*Bale bagadu haku, tengu telisi haku*).

(2) Sow the seed though you may not obtain a crop; do not later have occasion to think that you have nothing to reap because you did not sow (*Biththi kettaru kedu, biththade kedabeda*).

(3) Sow the seed suited to the soil, give alms according to the one who asks (*Khsethrakke thakka bija, pathrakke thakka dana*).

(4) Dry the seed meant for sowing ten times (*Biththa bija haththusari onagisu*).

(5) Seed should not be timed to germinate on a Tuesday (*Mangalavara molibaradu*).

(6) Seed unsown, crop unknown (*Biththade beleye?*).

(7) He who knows his seeds knows his job (*Bija ballava besaya balla*).

(8) Crops sown untimely and late are like the children of an aged man (*Akaladalli biththida bele mudiyana makkalanthe*).

(9) A crop that is sown in time, is like a maiden in her prime (*Samayavaritha biththane, vayasubanda kanye*).

(10) Sow your seeds thin and count your crop in measures (*Thellage biththu, balladalli alako*).

(11) If you sow the seeds thick you lose your crop. (*Oththada biththane kai hathithadu*).

(12) Can a seed of a bitter plant yield a tree of sweet fruits like the mango ? (*Bevina bija mavina mara kottithe*).

(13) The wealth of the harvest was evident in the wealth of the germination (*Beleya siri moleyalli*).

The wise farmer feels homely with his surroundings. He has a worshipful attitude towards the land he cultivates. He is calculative, but knows that his farming prospers not on dissensions but on co-operation.

(1) The shade of the Honge tree is like a mother's lap to her child (*Thayi madalu, honge nelalu*).

(2) As I rise in the morning my remembrance runs to many a deity
(*Yeddondu ghaligeli yaryara neneyali—*
First let me thank her that grows the sesame and the cumin—
(*Yellu jeerige beleyola—*
mother earth that grows the sesame and the cumin,
Yellu jeerige beleyo bhumi tayiya—
my prayer to her as I rise in the morning hour !
(*Yeddondu galigeli nenedeno* !).

(3) Examine the family before you give away your daughter; examine the hay stack before you give away your bullock (*Mane nodi, hennu kodu—mede nodi yeththu kodu*).

(4) When in the home is developing a quarrel,
The green field is all turning into thorn and trash, that is the moral
(*Manekade tarle, holada kade purle*).

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